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A STUDY OF THE RELATIONSHIP BETWEEN READING ACHIEVEMENT AND SENSE MODALITY SHIFTING.

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A STUDY WAS CONDUCTED TO DETERMINE THE RELATIONSHIP BETWEEN VISUAL AND AUDITORY SINGULAR MODAL RESPONSES AND MODAL SHIFTING BEHAVIOR TO READING ACHIEVEMENT WITH CONTROL FOR SUCH VARIABLES AS INTELLIGENCE, AGE, SEX, AND SOCIOECONOMIC STATUS. SUBJECTS WERE 120 SECOND, FOURTH, AND SIXTH GRADERS FROM PEORIA, ILLINOIS, PUBLIC ELEMENTARY SCHOOLS. MEASURES OF THE FOLLOWING VARIABLES WERE OBTAINED FOR EACH STUDENT--AUDITORY AND VISUAL REACTION TIMES, VISUAL-AUDITORY SHIFTING AND SINGULAR MODAL AUDITORY AND VISUAL RESPONSE, INTELLIGENCE, SOCIOECONOMIC STATUS, AND READING ACHIEVEMENT. CORRELATIONS AND T TESTS WERE USED TO ANALYZE THE DATA. MODAL SHIFTING WAS INDEPENDENT OF SOCIOECONOMIC STATUS. RANDOM RELATIONSHIPS EXISTED BETWEEN SENSE MODALITY SHIFTING AND READING ACHIEVEMENT. DIFFERENCES WERE NOT FOUND BETWEEN REACTION TIMES TO THE SINGULAR VISUAL AND AUDITORY CHANNELS AND THE SHIFTING BETWEEN THE TWO CHANNELS OF COMMUNICATION. REFERENCES AND TABLES ARE INCLUDED. (BK)

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# A STUDY OF THE RELATIONSHIP BETWEEN READING ACHIEVEMENT AND SENSE MODALITY SHIFTING

Cooperative Research Project No. 6-8688

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TABLE OF CONTENTS


| | | Page |
|---|---|---|
| I. | Statement of the Problem | 1 |
| II. | Objectives | 1 |
| III. | Related Research | 2 |
| IV. | Procedure | 3 |
| | a) Population and Sample | 3 |
| | b) Techniques Employed | 3 |
| | Reaction Time Apparatus | 3 |
| | Intelligence | 4 |
| | Reading Achievement | 4 |
| | Socio-Economic Scale | 4 |
| V. | Analysis of the Data and Findings | 4 |
| | Intravariable Relationships | 4 |
| | Group Relationships | 5 |
| | Test of Hypothesis | 6 |
| VI. | Conclusions and Implications | 7 |
| VII. | References | 9 |
| VIII. | Appendices | 11 |
| | Table 1 | 11 |
| | Table 2 | 12 |
| | Table 3 | 13 |
| | Table 4 | 14 |
| | Table 5 | 15 |

TABLE OF CONTENTS, CONT.


| | Page |
|---|---|
| Table 6 | 16 |
| Table 7 | 17 |
| Table 8 | 18 |
| Table 9 | 19 |
| Table 10 | 20 |
| Table 11 | 21 |

## I. PROBLEM

Research attention to reading behavior in recent years has encompassed a variety of perceptual functions. Many investigations into reading disability have focused on singular variables. The influence of sensory malfunction has been investigated mostly through singular modality assessment while there have been few studies concerned with the processing of information in both the auditory and visual channels. Achievement in reading could be hampered by attentional difficulties in the processing of sequential information in these two sense modalities, while there would be no defect singularly. The purpose of this study was to determine the relationship between visual and auditory singular modal responses and modal shifting behavior to reading achievement with control for such intervening variables as intelligence, age, sex and socio-economic status.

## II. OBJECTIVES

The research reported herein was designed to investigate the relationship between visual-auditory shifting and reading achievement when intelligence, sex, age and socio-economic status are controlled. In addition, subjects were selected from three grade levels, 2nd, 4th and 6th, to obtain developmental data on this perceptual function.

## III. RELATED LITERATURE

Visual and auditory perceptual malfunctions have been widely investigated. Research has mainly concerned the separate sense modalities, involving the study of defects in visual functions (Harris, 1956; McQuarrie, 1957; Goins, 1958; Ewalt, 1962) and auditory discrimination (Kennedy, 1942; Wepman, 1958; Deutsch, 1962; Otto, 1963 and Thompson, 1963). There has been considerable confusion concerning the etiological significance of these defects in the two sense modalities to reading achievement (Johnson, 1957). Two studies were recently conducted on the relationship between sense modality shifting (visual-auditory) and reading achievement. In 1961, Raab, Deutsch and Freedman noted a relationship between reading achievement and modality shifting behavior in 6th grade children. Katz and Deutsch (1963) investigated the performance of retarded readers on a task involving the shifting of attention between auditory and visual stimuli. This behavior was studied developmentally and they found that those children retarded in reading experienced greater difficulty responding to a cross-modal task, shifting from one channel of communication to another, than on a ipsi-modal task. Findings were independent of intelligence. The validity of these findings are questionable because of sample bias and the use of extreme groups for study. Too, intervening variables, such as cultural or socio-economic and sex factors were not controlled. Further research is needed to determine the significance of sensory modality shifting to reading achievement.

## IV. PROCEDURE

a) Population and Sample

Subjects for study were selected from the Peoria Public elementary schools. 120 students in all were chosen, 40 each (20 girls and 20 boys) from grades two, four and six. It was felt the range in grade would allow for the assessment of maturational factors in the perceptual ability measured. The 38 elementary schools were rated on a three point scale as to general socio-economic level and then schools were randomly selected from each of these categories to obtain a balanced representation of socio-economic level. Students were randomly selected from the class rosters. Measures of the following variables were collected on each student in the sample:

Auditory and visual reaction times

Visual-auditory shifting and singular modal auditory and visual response. (Sensory apparatus)

Intelligence (Wechsler Intelligence Scale for Children)

Socio-economic status (Socio-Economic Scale)

Reading achievement (California Achievement Test - Reading, Series WXYZ - 1963 norms)

b) Techniques Employed

Reaction-Time Apparatus: The sensory apparatus used in this experimentation has been described earlier by Sutton, et al (1961) and differs only in equipment design. Stimulus program and procedure followed that of Katz and Deutsch (1963). The stimuli consisted of a red light, green light and low and high tones of 400 cps and 1200 cps. Presentation was

automatic with random interval timing of 1.5, 2.0 and 3.0 seconds. Six blocks of thirty-three trials each were presented the subject, with a one minute delay between each block. The Subject responded by lifting his finger from a key and the reaction time was automatically recorded on tape. Mean reaction times were then computed for a) stimuli preceded by a S in the same modality and b) stimuli preceded by S in a different modality (cross-modal).

Intelligence: Intellectual ability was measured by an individually administered instrument, the Wechsler Intelligence Scale for Children, to control for the influence of reading defect on the intelligence results. This test was selected because of the advantage of having data on both verbal and performance ability and specific intellectual functions such as are measured by the subtests.

Reading Achievement: Reading Achievement Test, (Form W, WXYZ Series, 1963 Norms) was used to assess reading ability. The test provides a measure of both vocabulary and reading comprehension.

Socio-Economic Scale: The Socio-Economic Scale (Reiss, 1961) was selected because of its advantages over similar instruments available (e.g. N.O.R.C. Occupational Rating Scale). The ratings are made from the father's occupation and these numerical ratings were then classified in three major groups, high, medium and low.

## V. ANALYSIS OF THE DATA AND FINDINGS

### Intra-Variable Relationships

In the initial analysis of the data, mean shifting reaction time was compared with the single modal responses (S preceded by S in the same modality). However, Pearson Product moment correlations for all three grade groups

were quite high and therefore in subsequent analysis, only the modal shifting measure was used for comparison with other variables. The high correlation between reading vocabulary and reading comprehension subtests with total score negated the necessity of treating these as separate skills in further statistical analysis (Table Two).

Group Relationships

Since developmental factors in perceptual responsivity could be associated with reading defect, there was interest in group comparisons of the techniques employed. The grade groups were equivalent in intelligence and in socio-economic status as shown in Table Three. The groups did vary in reading ability and shifting RT. The fact that the 6th grade students showed greater variability may be the results of the larger proportion of Negroes in the 6th grade sample, which resulted from the random selection process (Table Four). More revealing information might have been obtained if the sample had been stratified for race as well as sex in view of the previous positive findings in the relationship of modal shifting reaction time to reading achievement. (Katz and Deutsch, 1963).

Tables 5, 6 and 7 contain group comparative information on the control variables for the entire sample. There were no significant sex differences in mean intelligence test scores, reading ability, modal shifting reaction times or socio-economic status (Table Five). The significant differences in all variables, except shifting RT, between Negro and white children (Table Six) is not inconsistent with previous research (Ellis and Davis, 1951: Semler and Iscoe, 1963; Haggard, 1954). The fact that group means in shifting RT were not significantly different could be accounted for by the high sampling error due to the low N (N = 20) of the Negro sample. Modal shifting was independent

of socio-economic status (Table Seven). However, both reading ability and intelligence were found to be significantly related to socio-economic status. This latter finding is supported by previous research. (Havinghurst and Janhe, 1944; Chauncey, 1929 and Parsons,1963).

Test of Hypothesis:

The hypothesis that there is a relationship between visual-auditory shifting behavior and reading achievement was not supported in this study as indicated in Table Eight. The highest correlation coefficient of .274 was not significant at the .05 level. The inconsistency in the direction of correlation for the three grade levels suggests only that random relationships exist between sensory modality shifting and reading achievement.

Because of racial group differences on the variables further analysis was conducted to determine if race was a possible factor influencing the results. All Negro students were omitted from the sample and correlations were computed for the remaining white students. Table Number Nine shows that there were some small changes in the coefficients by this method, but these were of insufficient magnitude to conclude that the Negro sample was effecting the significance of relationships.

It was not possible to test the implicit assumption in the study, that the relationship between sensory shifting behavior and reading ability level would be independent of intelligence because no relationship was established between the independent and dependent variables. In the groups studied, sensory shifting and intellectual ability are independent as evidenced in Table Number 10, and this confirms the findings of Katz and Deutsch (1963).

With the exception of one subtest (block design) in the 2nd grade group, the subtests correlations were insignificant.

Intellectual factors account for most of the variation in reading achievement (Table Number II). That this relationship increases with age is not surprising in view of the influence of achievement rate as measured in intellectual functioning.

Initially, the intention had been to analyze the data by multiple correlation techniques. This, of course, was obviated when the simple correlation analyses were not significant.

## VI. CONCLUSIONS AND IMPLICATIONS

That there is a relationship between sense modality shifting and reading achievement was not supported by the sample tested. Neither were differences found between reaction times to the singular visual and auditory channels and the shifting between the two channels of communication. These findings are somewhat inconsistent with that of Katz and Deutsch who studied a group of Negro children. However, the difference in experimental design of these two studies may account for this inconsistency since their study involved the relationship between extreme groups. One possible explanation of the difference in findings might be that while sensory shifting behavior may be a problem in cases of reading retardation,

it does not appear to be a problem in a normal sample.

Further replications with different population samples will be needed before valid conclusions can be made about the etiology of sensory communication processes and reading achievement.

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TABLE NUMBER I

Correlation - Shifting RT with Auditory and Visual Sub-Test.

| | Shifting RT | | |
|---|---|---|---|
| | 2nd Grade | 4th Grade | 6th Grade |
| Single Modal Response | .937 | .921 | .967 |

TABLE NUMBER 2

Correlation - Total Reading Achievement with Reading Comprehension and Reading Vocabulary Sub-Test.

| | 2nd Grade | 4th Grade | 6th Grade |
|---|---|---|---|
| Reading Vocabulary | .980 | .953 | .916 |
| Reading Comprehension | .925 | .977 | .972 |

TABLE NUMBER 3

Group Means, Standard Deviations
on all Variables and t Test*

| | 2nd Grade | 4th Grade | 6th Grade | t | P |
|---|---|---|---|---|---|
| SES Scale | $\bar{X}$ 38.50<br>SD 23.81 | $\bar{X}$ 37.13*<br>SD 26.78 | $\bar{X}$ 42.43*<br>SD 28.73 | .688 | NS |
| Shifting RT | $\bar{X}$ .434*<br>SD .075 | $\bar{X}$ .357<br>SD .063 | $\bar{X}$ .314*<br>SD .064 | 2.43 | .02 |
| Total Reading | $\bar{X}$ 2.33*<br>SD .71 | $\bar{X}$ 4.05<br>SD .64 | $\bar{X}$ 6.43*<br>SD 1.39 | 16.6 | .001 |
| WISC Total I.Q. | $\bar{X}$ 108.15*<br>SD 15.26 | $\bar{X}$ 106.00*<br>SD 16.31 | $\bar{X}$ 108.00<br>SD 19.18 | .535 | NS |

* t Test computed using means with the widest variation.

TABLE NUMBER 4

Distribution of Sex and Race

N = 120

| | 2nd Grade | 4th Grade | 6th Grade | Total |
|---|---|---|---|---|
| Male | 20 | 20 | 20 | 60 |
| Female | 20 | 20 | 20 | 60 |
| White | 34 | 35 | 31 | 100 |
| Negro | 6 | 5 | 9 | 20 |

TABLE NUMBER 5

| | | Sex | | | |
|---|---|---|---|---|---|
| | | Male | Female | t | P |
| Shifting RT | $\bar{X}$ | .363 | .373 | | |
| | SD | .80 | .86 | .060 | NS |
| Total Reading | $\bar{X}$ | 4.13 | 4.41 | | |
| | SD | 2.08 | 1.78 | .796 | NS |
| SES Scale | $\bar{X}$ | 36.07 | 42.63 | | |
| | SD | 26.31 | 26.51 | 1.78 | NS |
| WISC Total I.Q. | $\bar{X}$ | 106.37 | 108.40 | | |
| | SD | 18.24 | 15.65 | .660 | NS |

TABLE NUMBER 6

Race

| | N:100 White | N:20 Negro | t | P |
|---|---|---|---|---|
| Shifting RT | .353<br>.071 | .371<br>.085 | .78 | NS |
| Total Reading | 4.42<br>1.99 | 3.50<br>1.49 | 2.32 | .05 |
| SES Scale | 44.01<br>26.17 | 16.05<br>13.17 | 6.75 | .001 |
| WISC Total I.Q. | 110.57<br>16.19 | 91.45<br>11.12 | 6.37 | .001 |

TABLE NUMBER 7

† Table
Socio-Economic Status

| | Low | Medium | High | † | P |
|---|---|---|---|---|---|
| Shifting RT | .368 | *.375 | *.355 | | |
| | .077 | .083 | .096 | .995 | NS |
| Total Reading | *3.76 | 4.45 | *5.22 | | |
| | 1.60 | 2.02 | 2.17 | 3.42 | .001 |
| WISC Total I.Q. | *97.73 | 114.55 | *117.67 | | |
| | 15.58 | 12.97 | 14.51 | 5.94 | .001 |

TABLE NUMBER 8

Correlation - Shifting RT to Reading Achievement

REACTION TIME

| | 2nd Grade N = 40 | 4th Grade N = 40 | 6th Grade N = 40 |
|---|---|---|---|
| Reading Vocabulary | -.198 | .233 | -.188 |
| Reading Comprehension | -.128 | .256 | -.272 |
| Reading Total | -.184 | .245 | -.254 |

N = 40, P = .05 = .304, P = .01 = .393

TABLE NUMBER 9

Correlation - Shifting RT with Reading Achievement
(White Sample Only)

REACTION TIME

| | 2nd Grade N = 34 | 4th Grade N = 35 | 6th Grade N = 31 |
|---|---|---|---|
| Reading Vocabulary | -.292 | .187 | -.159 |
| Reading Comprehension | -.203 | .198 | -.233 |
| Reading Total | -.269 | .200 | -.230 |

N = 35, P = .05 = 325, P = .01 = 418

TABLE NUMBER 10

Correlations of Shifting RT with WISC[1] Variables

| | GRADE | | |
|---|---|---|---|
| | N=40<br>2nd | N=40<br>4th | N=40<br>6th |
| Information | -.143 | .104 | -.249 |
| Comprehension | -.095 | -.206 | -.167 |
| Arithmetic | -.251 | -.193 | -.078 |
| Similarities | -.249 | .007 | -.270 |
| Vocabulary | -.076 | -.081 | -.282 |
| Digit Span | -.103 | .076 | -.285 |
| Picture Completion | -.168 | .045 | -.259 |
| Picture Arrangement | -.087 | .133 | -.015 |
| Block Design | -.347* | .254 | -.151 |
| Object Assembly | -.232 | .262 | -.187 |
| Digit Symbol | -.290 | -.028 | -.213 |
| Sub-Total - Verbal | -.002 | .066 | -.265 |
| Sub-Total - Memory | -.140 | .157 | -.253 |
| Total | -.073 | .057 | -.277 |

N = 40, P = .05 = 304, P = .01 = 393

[1]For a description of the WISC sub-test, see Appendix.

TABLE NUMBER II

Correlation Between Reading and WISC
Subtests and Total Scores

GRADE

| | N=40<br>2nd | N=40<br>4th | N=40<br>6th |
|---|---|---|---|
| Information | .578** | .560* | .776** |
| Comprehension | .286 | .184 | .705** |
| Arithmetic | .485** | .399** | .635** |
| Similarities | .572** | .494** | .714** |
| Vocabulary | .486** | .458** | .680** |
| Digit Span | .166 | .532** | .568** |
| Picture Completion | .316* | .254 | .405** |
| Picture Arrangement | .408** | .381* | .625** |
| Block Design | .602** | .302 | .757** |
| Object Assembly | .406** | .325* | .585** |
| Digit Symbol | .511** | .241 | .629** |
| Verbal Scale | .551** | .672** | .912** |
| Performance Scale | .614** | .563** | .904** |
| Total Scale | .638** | .660** | .951** |

N = 40, *P = 05 = .304, **P = 01 = .393